(12) UK Patent Application (19) GB (11) 2 071 564 A

(21) Application No 8002864
(22) Date of filing 28 Jan 1980
(43) Application published 23 Sep 1981
(51) INT CL³ D06H 5/00 C09J 5/00
(52) Domestic classification B5K 3
(56) Documents cited
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(58) Field of search B5K
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(54) Improvements in and relating to the manufacture of protective clothing

(57) A method of forming a seam 10 in two sheets 11, 12 of protective fabric, e.g. nylon fabric coated with polyurethane or siliconized on one surface 11*a*, 12*a*, comprises

laying a strip 13 of fusible tape, e.g. polyvinyl chloride, so that it embraces the aligned edge portions 11*b*, 12*b* of the sheets;

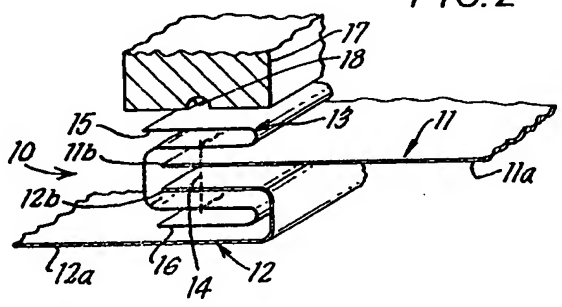
sewing the two sheets and the tape together with a single line of stitching 14 extending generally parallel with the aligned edges to leave free tape flaps 15, 16 the tape extending beyond the stitching 14;

folding the sheet 12 and the flap 16 about the line of stitching 14;

folding the flap 15 about the line of stitching 14; and

applying energy to the seam to fuse the tape 13 and seal the line of stitching. Fusion of the tape 13 may be by high frequency energy applied by a welding bar 17 having a groove 18 therein or a welding bar comprising two relatively movable sections or by ultrasonic energy.

FIG. 2



The drawing originally filed was informal and the print here reproduced is taken from a later filed formal copy.

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FIG.1

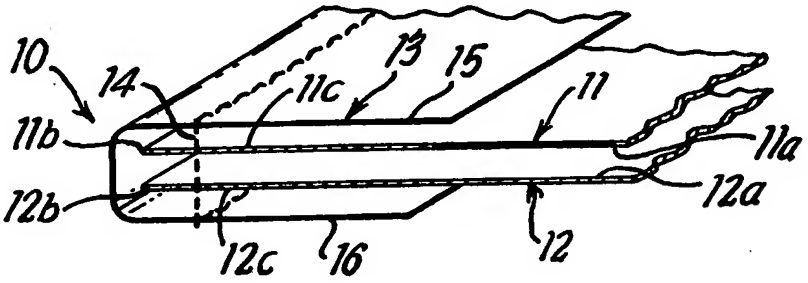


FIG.2

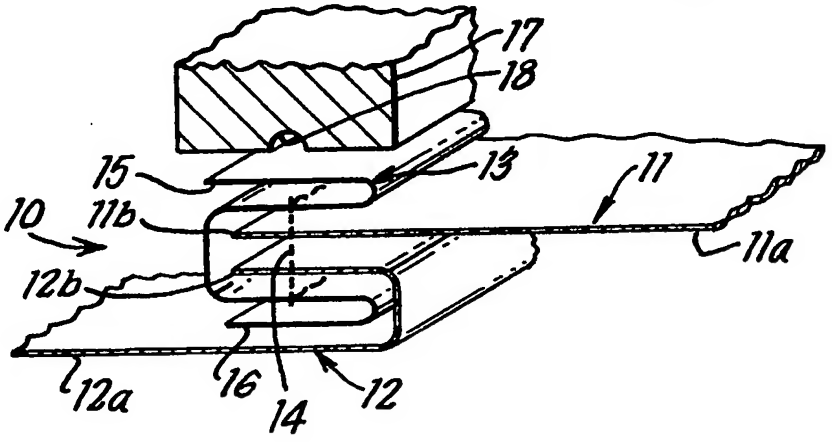
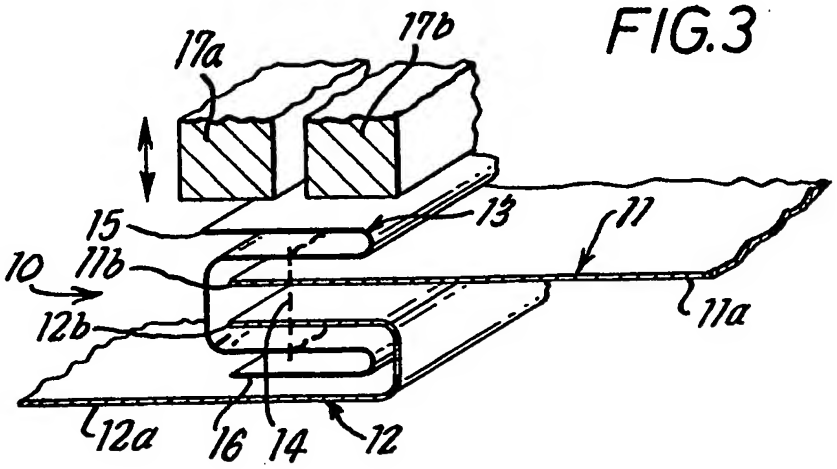


FIG.3



SPECIFICATION

Improvements in and relating to the manufacture of protective clothing

This invention relates to waterproof articles and in particular waterproof clothing such as jackets, trousers and overalls and to a method of manufacturing such waterproof articles.

In the manufacture of waterproof clothing from impermeable material, it is important to ensure that water cannot permeate through the seams of the clothing. In order to overcome this problem it is known to spray or paint the inside surface of the seams with a waterproof compound or to apply a strip of adhesive tape to the underside of the seams. It is also known to use a sewing thread which will swell when it becomes wet so as to fill the holes of the seam. It is also known to sew a tape of fusible material into the seam or seams and then apply heat or high frequency energy to the seam so as to fuse the tape within the seam thereby filling and sealing the holes of the stitching.

We have found that all of these known methods of sealing a seam in a waterproof material have disadvantages of one kind or another in that they are either costly or they do not ensure a completely water impermeable seam under all conditions. In particular we have found that problems arise in forming a seam between two sheets of fabric which have been treated on one side with a material which will not easily bond, for instance by forming a siliconised finish or by coating the material with polyurethane. It is therefore an object of the present invention to provide a method of forming and sealing a seam between two sheets of protective fabric which is economic in terms of labour costs and material and which will form an effective seal regardless of the nature of the fabric or the conditions of use.

According to one aspect of the present invention we provide a method of forming a seam in two sheets of protective fabric comprising the steps of

laying the two sheets one on top of the other with an edge of the first sheet aligned with an edge of the second sheet;

laying a strip of fusible tape along aligned edges of the sheets so that the strip of fusible tape embraces the aligned edge portions of the sheets;

sewing the two sheets and the tape together with a single line of stitching extending generally parallel with the aligned edges to leave portions of the tape extending beyond the line of stitching to form free tape flaps;

folding the first sheet and the free tape flap which overlies the first sheet about the line of stitching so that the tape flap overlies the line of stitching within the fold in the first sheet;

folding the other tape flap which overlies the second sheet about the line of stitching so as to overlie the line of stitching and

applying energy to the seam to fuse the tape and seal the line of stitching.

If the fabric is coated or treated on one side, for instance if it has a siliconised finish or is coated with a polyurethane which will not readily bond to the material of the fusible tape, the two sheets of protective fabric are laid one on top of the other with the treated surfaces facing inwardly so that the tape is laid on the untreated surfaces of the sheets. Effective bonding can then take place between the tape and the untreated surfaces of the fabric.

The method of the present invention may be employed with a wide range of fabrics, such as nylon, nylon coated with either polyurethane or polyvinyl chloride or any other suitable fabric which may also be provided with an additional water-proof finish such as by siliconising. The tape of fusible material is preferably a tape of unsupported polyvinyl chloride which can be fused and welded readily by the application of high frequency energy in a well known manner.

Preferred forms of the present invention will now be described with reference to the accompanying drawings, in which:—

Figure 1 is a diagrammatic illustration of a seam which has been stitched but not yet welded;

Figure 2 shows the seam of Figure 1 and the welding bar immediately prior to welding; and

Figure 3 is a view similar to Figure 2 but showing an alternative form of welding bar.

In Figures 1 and 2 a seam is indicated generally at 10 which is formed between first and second sheets of fabric 11 and 12, respectively, so as to join the sheets of fabric together. The sheets of fabric 11 and 12 are formed from any suitable water impermeable material, such as a nylon fabric which may be coated with polyurethane and which may also be siliconised on one surface to increase the waterproofing and enhance the feel and texture of the material.

In order to form the seam 10, the sheets 11 and 12 are laid one on top of the other with the treated surfaces 11a and 12a, respectively, which are to form the outer surface of the article of clothing facing inwardly and contiguous with one another. The two sheets 11 and 12 are also positioned with edges 11b, 12b, respectively, aligned with one another.

A strip of fusible tape 13 is then wrapped around the edges 11b and 12b so as to overlie the marginal edge portions 11c and 12c of the sheets. The tape 13 is formed from a material which will melt and fuse when subjected to high frequency energy and preferably comprises a strip of unsupported polyvinyl chloride. The width of the tape 13 is such that two tape flaps 15 and 16 are left beyond the line of stitching 14 overlying the sheets 11 and 12, respectively.

The free flaps 15 and 16 of the tape 13 are then folded back so as to overlie the line of stitching, as shown in Figure 2. Finally, the sheet 12 is folded back about the line of stitching so as to overlie the flap 16.

The seam is then completed by applying high frequency energy to fusible tape 13 so as to melt and fuse the tape throughout the seam, thereby bonding and sealing the line of stitching. The high

frequency is applied by conventional high frequency electronic welding apparatus incorporating a welding bar 17. The welding bar is applied to the flap 15 of the fusible tape which in turn overlies the surface of the sheets 11 and 12 which will form the inside surface of the finished garment. The application of the high frequency energy by the welding bar will fuse the material of the tape throughout the seam to the sheets 11 and 12 to form a strong impermeable seam. During the application of high frequency energy a certain amount of heat will be generated, but not sufficient to damage the fabric of the sheets 11 and 12.

In conventional welding machines, it is usual for the welding face of the welding bar to be substantially flat. We have found that the use of flat welding face cun result in the generation or excessive temperatures in the region of the line of stitching and consequent damage to the plastics material which lies directly on top of the stitching. If this damage occurs during the welding operation the seam may fail subsequently. We have overcome this problem by forming a groove 18 in the welding surface of the welding bar, as shown in Figure 2, or alternatively by forming the welding bar in two spaced sections 17*a*, 17*b* as shown in Figure 3.

If the welding bar is formed with a groove 18, as shown in Figure 2, the groove 18 is positioned directly over the line of stitching during the welding operation and this eliminates any risk of excessive heat being generated and damaging the material covering the line of stitching.

If the welding bar is formed in two sections 17*a*,17*b*, one of the two sections 17*a* is arranged to be movable vertically relative to the other section 17*b*. During the welding operation, the welding bar is positioned over the material with the line of stitching aligned with the gap 19 between the sections 17*a*,17*b* so that again there is no risk of high temperatures being generated by the raised line of stitching. The section 17*a* can be adjusted vertically to vary the pressure applied to the material on one side of the line of stitching relative to the other.

In the finished seam 20, it will be seen that both sides of the line of stitching are covered by the flaps 15 and 16 of the fusible tape so as to form a complete seal of the stitch line. It will further be seen that the fusible tape 13 is contiguous with the surfaces of the sheets 11 and 12 which form the inner surface of the garment and which will therefore normally be untreated and will more readily bond to the fusible tape.

The choice of material for the fusible tape will depend upon the method of welding to be used and the nature of the fabric forming the garment. For instance, it may be preferable in certain circumstances to fuse the tape by the application of heat, in which case a fusible tape material will be chosen which will melt and fuse at a substantially lower temperature than the fabric. Alternatively it is envisaged that the seam may be welded by the application of ~~ultra-sonic energy~~ rather than high frequency energy.

CLAIMS

1. A method of forming a seam in two sheets of protective fabric comprising the steps of

laying the two sheets one on top of the other with an edge of the first sheet aligned with an edge of the second sheet;

laying a strip of fusible tape along the aligned edges of the sheets so that the strip of fusible tape embraces the aligned edge portions of the sheets;

sewing the two sheets and the tape together with a single line of stitching extending generally parallel with the aligned edges to leave portions of the tape extending beyond the line of stitching to form free tape flaps;

folding the first sheet and the free tape flap which overlies the first sheet about the line of stitching so that the tape flap overlies the line of stitching within the fold in the first sheet;

folding the other tape flap which overlies the second sheet about the line of stitching so as to overlie the line of stitching and

applying energy to the seam to fuse the tape and seal the line of stitching.

2. A method as claimed in claim 1, wherein a surface of each sheet is treated or coated to render it impermeable, the two sheets being laid one on top of the other with the treated or coated surfaces facing one another prior to the step of stitching the sheets and the tape together.

3. A method as claimed in claim 1, wherein energy is applied to the seam to fuse the tape through the outer tape flap which overlies the second sheet.

4. A method as claimed in any preceding claim, wherein the tape is fused and welded by the application of high frequency energy.

5. A method as claimed in any preceding claim, wherein the high frequency energy is applied by a welding bar positioned over the tape flat which overlies the line of stitching on the surface of the second sheet, the welding bar being formed with a groove aligned with the line of stitching.

6. A method as claimed in any of claims 1 to 4, wherein the welding bar comprises two sections which are spaced laterally to form a gap, the welding bar being positioned relative to the seam during the welding operation with the line of stitching aligned with the gap between the two welding bar sections.

7. A method as claimed in claim 6, wherein one of the welding bar sections is movable relative to the other to vary the pressure applied by section to the seam.

8. A method as claimed in any preceding claim, wherein the sheets comprise a base fabric coated with polyvinyl chloride.

9. A method as claimed in any of claims 1 to 7, wherein the sheets comprise a nylon fabric coated

on one surface with polyurethane.

10. A method as claimed in any of claims 1 to 7, wherein a surface of each sheet is siliconised.

11. A method as claimed in any preceding claim, wherein the fusible tape comprises an unsupported polyvinyl chloride tape.

12. An article or protective clothing made by the method of any preceding claim.

13. A method of forming a seam in two sheets of protective fabric substantially as described herein with reference to Figures 1 and 2 of the accompanying drawings.

14. Apparatus for welding a stitched seam in a synthetic plastics material by the application of high frequency energy to the material comprising a welding bar formed with a groove adapted to overlie the line of stitching during the application of high frequency energy to the seam and means for supplying high frequency energy to the welding bar.

15. Apparatus as claimed in claim 14 wherein the welding bar has a generally flat surface adapted to overlie the seam, the groove being formed in the otherwise generally flat surface.

16. Apparatus for welding a stitched seam in a synthetic plastics material by the application of high frequency energy to the material comprising a welded bar and means for supplying high frequency energy to the welded bar, whenever the welding bar comprises two sections which are spaced laterally to form a gap therebetween.

17. Apparatus as claimed in claim 16, wherein one of the welding bar sections is movable relative to the other.

18. Apparatus for welding a stitched seam in a synthetic plastics material by the application of high frequency energy substantially as described herein with reference to Figure 2 or Figure 3 of the accompanying drawings.

New claims or amendments to claims filed on 26 FEB 81

Superseded claims 1, 2 and 5

New or amended claims:—

Claims 3, 4 and 6—18 re-numbered and appendices corrected

1. A method of forming a seam intwo sheets of protective fabric comprising the steps of

laying the two sheets one on top of the other with an edge of the first sheet aligned with an edge of the second sheet;

laying a strip of fusible tape along the aligned edges of the sheets so that the strip of fusible tape embraces the aligned edge portions of the sheets;

sewing the two sheets and the tape together with a single line of stitching extending generally parallel with the aligned edges to leave portions of the tape extending beyond the line of stitching to form free tape flaps;

folding the first sheet and the free tape flap which overlies the first sheet about the line of stitching so that the tape flap overlies the line of stitching within the fold in the first sheet;

folding the other tape flap which overlies the second sheet about the line of stitching so as to overlie the line of stitching; and

applying energy to the seam to fuse the tape and seal the line of stitching,

wherein a surface of each sheet is treated or coated to render it impermeable, the two sheets being laid one on top of the other with the treated or coated surfaces facing one another prior to the step of stitching the sheets and the tape together.

4. A method as claimed in any preceding claim, wherein the high frequency energy is applied by a welding bar positioned over the tape flap which overlies the line of stitching on the surface of the second sheet, the welding bar being formed with a groove aligned with the line of stitching.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1981. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.